Patent claims

1. An illumination system for a microlithography projection exposure installation for illuminating an illumination field (7) with the light of an assigned light source (10), wherein there is located in at least one pupil plane (23, 62) of the illumination system at least one polarization compensator (11) that has at least one polarization changer (11a; 11b) for influencing the polarization state of the light distribution in the pupil plane (23, 62) as a function of location, and is designed for partially or completely compensating polarization changes caused by angularly-dependent polarization changing optical elements (5) of the illumination system.

2. The illumination system as claimed in claim 1, wherein the polarization compensator (11) has a polarization changing function that varies as a function of location and has an even radial symmetry with reference to an optical axis (19) of the polarization compensator (11), in particular a twofold or fourfold radial symmetry.

3. The illumination system as claimed in claim 1 or 2, wherein the illumination system has an integrator rod arrangement (5) with a light entry surface (5a) and a light exit surface (5b), and the integrator rod arrangement (5) has a polygonal, in particular rectangular, cross section with rod sides (17) and rod corners (16).

4. The illumination system as claimed in claim 3, wherein the polarization compensator (11) has a number, corresponding to the number of the rod corners (16), of first sectors (12) with a first polarization changing effect, and of second sectors (13), corresponding to the number of the rod sides (17) and lying in the

circumferential direction of the polarization compensator (11) between the first sectors (12), with the second polarization changing effect, the first sectors (12) lying in angular sections assigned to the rod corners (16), and the second sectors (13) lying in angular sections assigned to the rod sides (17), and the first and second polarization changing effects being different.

5. The illumination system as claimed in one of claims 3 and 4, wherein the illumination system has a device (9, 20), for generating a quadrupole-shaped light distribution in a pupil plane (23) that can be set in such a way that regions of high light intensity of the quadrupole-shaped light distribution are localized in angular sections in which the rod corners (16) are also localized.

6. The illumination system as claimed in one of the preceding claims, wherein a diffractive or refractive optical raster element (8) with a two-dimensional raster structure is located in or in the vicinity of a pupil plane (23) of the illumination system, particularly in the light path upstream of the light entry surface (5a) of the integrator rod arrangement, and the polarization compensator (11) is positioned in or in the vicinity of the pupil plane (23).

7. The illumination system as claimed in one of the preceding claims, wherein the illumination system has an imaging objective (6) for imaging a field plane, in particular the light exit plane (5b) of the integrator rod arrangement (5), onto the illumination field (7), and the polarization compensator (11) is located in or in the vicinity of a pupil plane (62) of the imaging objective (6).

8. The illumination system as claimed in one of the

preceding claims, wherein as polarization changer the polarization compensator (11) has a raster element (11a) with a two-dimensional arrangement of elements (18) made from birefringent material of different thickness and/or different crystal orientation and/or of elements with different birefringent structures.

9. The illumination system as claimed in one of the preceding claims, wherein as polarization changer the polarization compensator (11) comprises a plate (11b) that has a height profile (30) made from a birefringent material of variable thickness.

10. A method for producing a polarization compensator (11) for introduction into an illumination system, having the following steps:
determining an angularly dependent variation in polarization within the illumination system that is caused by at least one angularly-dependent polarization changing optical element (5);
calculating a polarization change that varies as a function of location in a pupil plane (23, 62) in order to compensate the angularly-dependent polarization change;
producing the polarization compensator (11) in such a way that the location-dependent polarization change is suitable for at least partial compensation of the angularly-dependent polarization change; and
locating the polarization compensator (11) in or in the vicinity of a pupil plane (23, 62) of the illumination system such that the desired compensation effect occurs.

11. The method as claimed in claim 10, wherein the polarization compensator (11) is produced as a raster element (11a) with a two-dimensional arrangement of elements (18) made from birefringent material or elements with different birefringent structures whose

thickness and/or crystal axis orientation is prescribed as a function of location such that the location-dependent polarization change is suitable for compensating the angularly-dependent polarization change.

12. The method as claimed in one of claims 10 and 11, wherein the illumination system has an integrator rod arrangement (5) with a light entry surface (5a) and a light exit surface (5b), and the integrator rod arrangement (5) has a polygonal cross section with rod sides (17) and rod corners (16), and wherein the polarization compensator (11) has a number, corresponding to the number of the rod corners (16), of first sectors (12) with a first polarization changing effect, and of second sectors (13), corresponding to the number of the rod sides and lying in the circumferential direction of the polarization compensator between the first sectors (12), with a second polarization changing effect, the first sectors (12) lying in angular sections assigned to the rod corners (16), and the second sectors (13) lying in angular sections (17) assigned to the rod sides, and the first and second polarization changing effects being different.

13. The method as claimed in one of claims 10 to 12, wherein in order to calculate the location-dependent polarization change, averaging is carried out over all the points of a field plane (5a) that is related by Fourier transformation to the pupil plane (23, 62) that is provided for locating the polarization compensator (11).

14. A microlithography projection exposure installation having an illumination system and a projection objective, wherein the illumination system is designed as claimed in one of claims 1 to 9.

15. The microlithography projection exposure installation as claimed in claim 14, wherein the projection objective comprises a physical beam splitter with a polarization selective beam splitter surface.